ANNEX 5

(of Appendix 30 (S30))

(MOD)

Technical Data Used in Establishing the Provisions and Associated Plans and Which Should Be Used for Their Application[1]

1. DEFINITIONS

(MOD)

1.1 Downlink service area

The area on the surface of the Earth in which the administration responsible for the service has the right to demand that the agreed protection conditions be provided.

NOTE - In the definition of service area, it is made clear that within the service area the agreed protection conditions can be demanded. This is the area where there should be at least the wanted power flux-density and protection against interference based on the agreed protection ratio for the agreed percentage of time.

(MOD)

1.2 Downlink coverage area

The area on the surface of the Earth delineated by a contour of a constant given value of power flux-density which would permit the wanted quality of reception in the absence of interference.

NOTE 1 - In accordance with the provisions of No. **S23.13** of the Radio Regulations, the coverage area must be the smallest area which encompasses the service area.

NOTE 2 - The coverage area, which will normally encompass the entire service area, will result from the intersection of the antenna beam (elliptical, circular, or shaped) with the surface of the Earth, and will be defined by a given value of power flux-density. For example, it would be the area delineated by the contour corresponding to the level specified in 3.16 of this Annex. There will usually be an area outside the service area but within the coverage area in which the power flux-density will be at least equivalent to the minimum specified value; however, protection against interference will not be provided in this area.

[1] In revising this Annex at WRC-97, no changes have been made to the technical data applicable to the Region 2 Plan. However, for all three Regions, it should be noted that some of the parameters of networks proposed as modifications to the Plans may differ from the technical data presented herein.

NOTE 3 - If coverage is provided by a steerable beam, the contour delineating the coverage area will depend on the pointing capability of the beam and will not necessarily cover the entire service area.

(MOD)

1.3 Downlink beam area

The area delineated by the intersection of the half-power beam of the satellite transmitting antenna with the surface of the Earth. The downlink beam area concept was generally used for planning purposes in conjunction with elliptical beams.

NOTE - The beam area is simply that area on the Earth's surface corresponding to the –3 dB points on the satellite antenna radiation pattern. In many cases the beam area would almost coincide with the coverage area, the discrepancy being accounted for by the permanent difference in path lengths from the satellite throughout the beam area, and also by the permanent variations, if any, in propagation factors across the area. However, for a service area where the maximum dimension as seen from the satellite position is less than 0.6° in Regions 1 and 3, and less than 0.8° in Region 2 (the agreed minimum practicable satellite antenna half-power beamwidths), there could be a significant difference between the beam area and the coverage area.

NOC

1.4 Nominal orbital position

The longitude of a position in the geostationary-satellite orbit associated with a frequency assignment to a space station in a space radiocommunication service. The position is given in degrees from the Greenwich meridian.

(MOD)

1.5 Adjacent channel

The RF channel in the broadcasting-satellite service frequency Plan, or in the associated feeder-link frequency Plan, which is situated immediately higher or lower in frequency with respect to the reference channel.

(MOD)

1.6 Second adjacent channel

The RF channel in the broadcasting-satellite service frequency Plan, or in the associated feeder-link frequency Plan, which is situated immediately beyond either of the adjacent channels, with respect to the reference channel.

(MOD)

1.7 Overall carrier-to-interference ratio

The overall carrier-to-interference ratio is the ratio of the wanted carrier power to the sum of all interfering RF powers in a given channel including both feeder links and downlinks. The overall carrier-to-interference ratio due to interference from the given channel is calculated as the reciprocal of the sum of the reciprocals of the feeder link carrier-to-interference ratio and the down-link carrier-to-interference ratio referred to the satellite receiver input and earth station receiver input, respectively.[1]

(MOD)

1.8 Overall co-channel protection margin

The overall co-channel protection margin in a given channel is the difference in decibels between the overall co-channel carrier-to-interference ratio and the co-channel protection ratio.

(MOD)

1.9 Overall adjacent channel protection margin

The overall adjacent channel protection margin is the difference in decibels between the overall adjacent channel carrier-to-interference ratio and the adjacent channel protection ratio.

(MOD)

1.10 Overall second adjacent channel protection margin

The overall second adjacent channel protection margin is the difference in decibels between the overall second adjacent channel carrier-to-interference ratio and the second adjacent channel protection ratio

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(MOD)

[1] There are a total of five overall carrier-to-interference ratios used in the analysis of the Plan for the broadcasting-satellite service in Region 2, namely, co-channel, upper and lower adjacent channels, and upper and lower second adjacent channels. In Regions 1 and 3, three ratios are normally used, namely, co-channel and upper and lower adjacent channels. However, see the footnote to the definition of M_4 and M_5 in Section 1.11 of this Annex.

(MOD)

1.11 Overall equivalent protection margin[1]

The overall equivalent protection margin M is given in decibels by the expression:

$$M = -10 \log \left(\sum_{i=1}^{5} 10^{(-M_i/10)} \right) \qquad \text{(dB)}$$

where:

M_1	=	overall co-channel protection margin, in dB (as defined in Section 1.8 of this Annex);
M_2, M_3	=	overall adjacent channel protection margins for the upper and lower adjacent channels respectively, in dB (as defined in Section 1.9 of this Annex);
M_4, M_5[2]	=	overall second adjacent channel protection margins for the upper and lower second adjacent channels respectively, in dB (as defined in Section 1.10 of this Annex).

The adjective "equivalent" indicates that the protection margins for all interference sources from the adjacent and second adjacent channels as well as co-channel interference sources have been included.

(MOD)

[1] For calculation of over all equivalent protection margin for Regions 1 and 3, as defined at WARC-88, see alternative formula in Section 1.12 of Annex 3 of Appendix 30A (S30A).

(MOD)

[2] M4 and M5 are normally applicable only for Region 2. However, in certain cases (e.g. when the channel spacing and/or bandwidth of an assignment are different from the values given in Sections 3.5 and 3.8 of this Annex), these margins may also be used for Regions 1 and 3, provided that appropriate protection masks are included in ITU-R Recommendations. Until a relevant ITU-R Recommendation is incorporated in this Annex by reference, the Bureau will use the worst case approach as adopted by the Radio Regulations Board.

2. RADIO PROPAGATION FACTORS

In Regions 1 and 3:

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2.1 The propagation loss on the space-to-Earth path (used for computing downlink e.i.r.p. and as a guide in choosing orbital locations during the development of the Plan) is equal to the free space path loss plus the atmospheric absorption and the rain attenuation exceeded for 1% of the worst month. Values of this attenuation can be calculated as a function of angle of elevation for the rain-climatic zones shown in Figures 1 and 2 from Recommendation ITU-R P.837-1 by applying the method described in Recommendation ITU-R P.618-5.

In Region 2:

(MOD)

2.2 The propagation loss on a space-Earth path is equal to the free space path loss plus the atmospheric absorption loss plus the rain attenuation exceeded for 1% of the worst month.

FIGURE 1

Rain climatic zones for Regions 1 and 3 between longitudes 45° W and 105° E

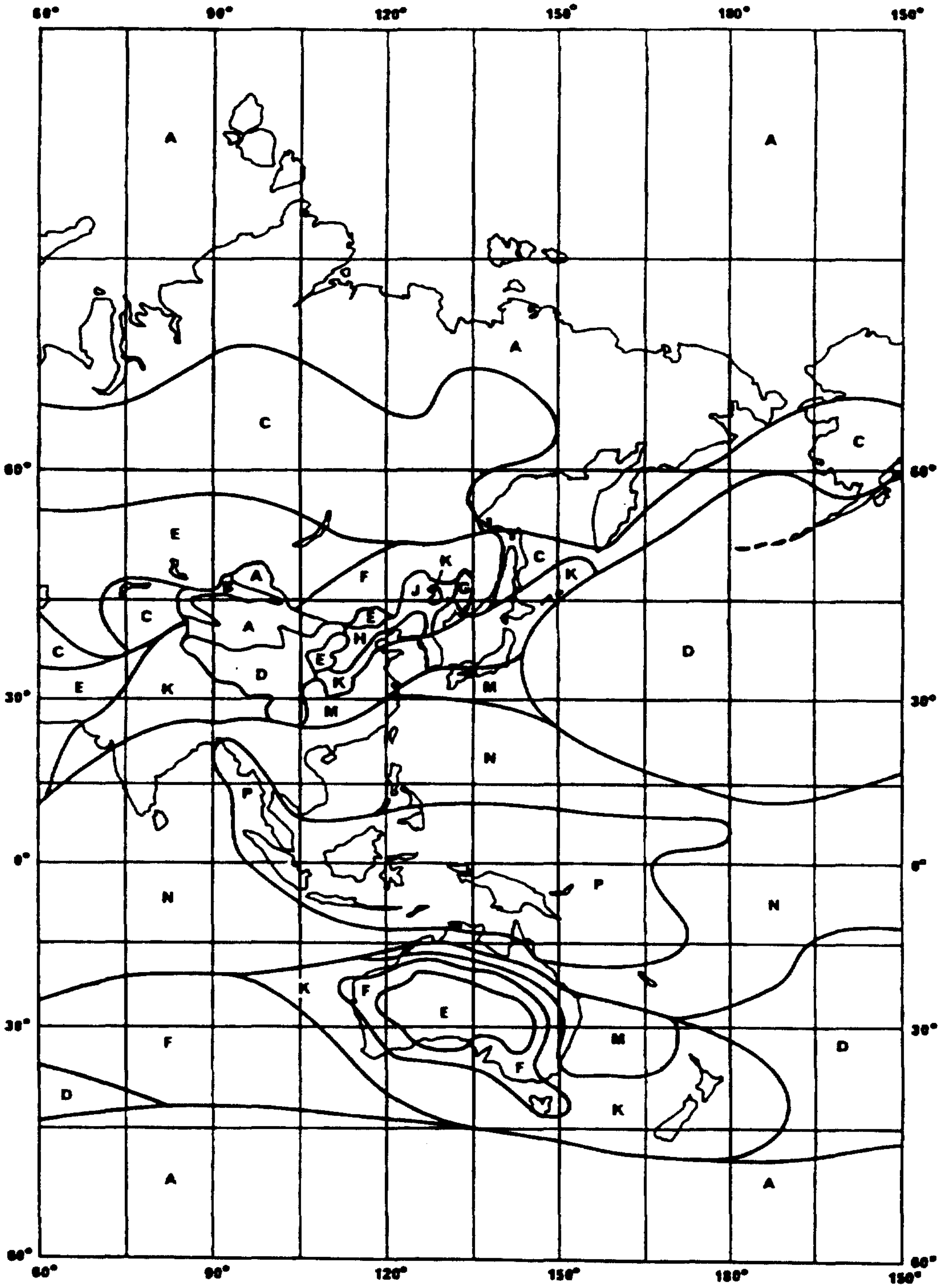

FIGURE 2

Rain climatic zones for Regions 1 and 3 between longitudes 60° E and 150° W

(MOD)

2.2.1 Atmospheric absorption

The loss due to atmospheric absorption (i.e. clear sky attenuation) is given by:

$$A_a = \frac{92.20}{\cos\theta}\left[0.017 F_o + 0.002\,\rho F_w\right] \quad \text{(dB)} \qquad \text{for } \theta < 5°$$

where:

$$F_o = \left[24.88 \tan\theta + 0.339\sqrt{1416.77 \tan^2\theta + 5.51}\right]^{-1}$$

$$F_w = \left[40.81 \tan\theta + 0.339\sqrt{3811.66 \tan^2\theta + 5.51}\right]^{-1}$$

and:

$$A_a = \frac{0.042 + 0.003\,\rho}{\sin\theta} \quad \text{(dB)} \qquad \text{for } \theta \geq 5°$$

where:

$\theta =$ elevation angle (degrees),

$\rho =$ surface water vapour concentration, g/m³, being

$\rho =$ 10 g/m³ for rain-climatic zones A to K and

$\rho =$ 20 g/m³ for rain-climatic zones M to P (see Figure 3).

(MOD)

2.2.2 Rain attenuation

The rain attenuation A_p of circularly polarized signals exceeded for 1% of the worst month at 12.5 GHz is given by:

$$A_p = 0.21\,\gamma\,L\,r \quad \text{(dB)} \tag{1}$$

where:

L is the slant path length through rain

$$= \frac{2(h_R - h_0)}{\left\{\sin^2\theta + 2\dfrac{h_R - h_0}{8500}\right\}^{1/2} + \sin\theta} \quad \text{(km)}$$

r is the rain path length reduction factor

$$= \frac{90}{90 + 4L\cos\theta}$$

h_R is the rain height (km)

$$c = \left\{ 5.1 - 2.15 \log \left(1 + 10^{(\zeta - 27)/25} \right) \right\} \quad \text{(km)}$$

$c = 0.6$ for $|\zeta| \leq 20°$

$c = 0.6 + 0.02\,(|\zeta| - 20)$ for $20° < |\zeta| \leq 40°$

$c = 1.0$ for $|\zeta| > 40°$

h_0 is the height (km) above mean sea level of the earth station;

ζ: is the earth station latitude (degrees);

θ: is the elevation angle (degrees);

γ: is the specific rain attenuation = $0.0202\ R^{1.198}$ dB/km;

R: is the rain intensity (mm/h) obtained from the Table below for the rain climatic zones identified in Figure 3.

(NOTE - The method is based on R exceeded for 0.01% of an average year.)

Rainfall intensity (R) for the rain climatic zones (exceeded for 0.01% of an average year) (see Figure 3)

Rain climatic zone	A	B	C	D	E	F	G	K	M	N	P
Rainfall intensity (mm/h)	8	12	15	19	22	28	30	42	63	95	145

Figure 4 presents plots of rain attenuation, as calculated using equation (1), of circularly polarized signals exceeded for 1% of the worst month at 12.5 GHz, as a function of earth station latitude and elevation angle for each of the rain climatic zones shown in Figure 3.

(MOD)

2.2.3 Rain attenuation limit

In the analysis of the Plan for the broadcasting-satellite service in Region 2, a maximum down-link attenuation of 9 dB was agreed in order to limit the inhomogeneity of broadcasting-satellite power flux-density and to facilitate sharing during clear-sky conditions.

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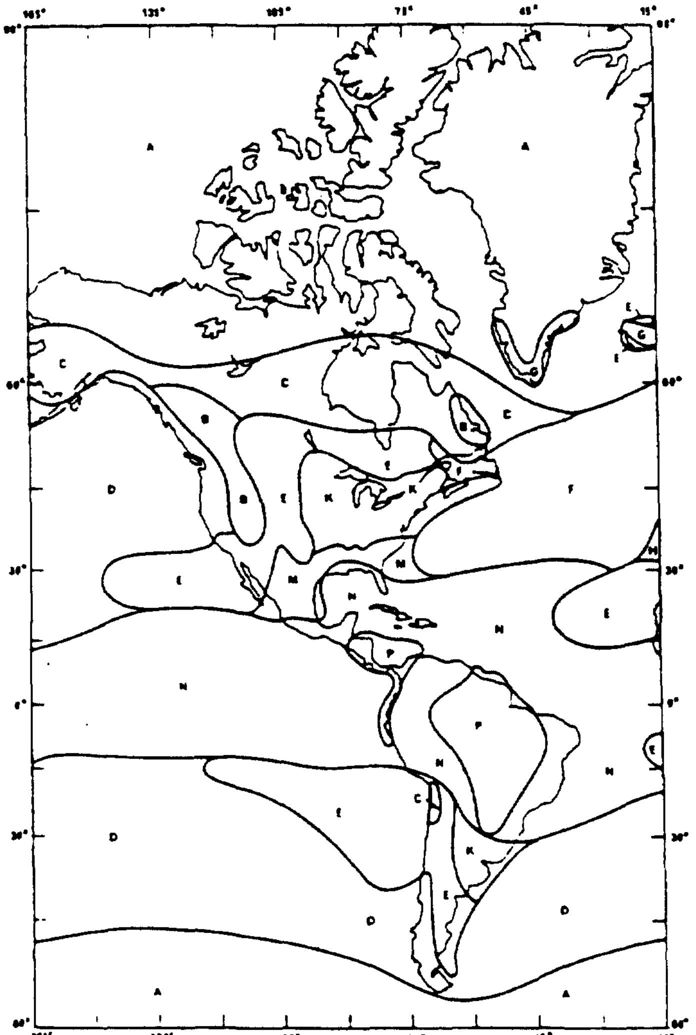

FIGURE 3

Rain-climatic zones (Region 2)

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2.2.4 Procedure for calculating the carrier-to-interference ratio at a test point

The calculation of the down-link carrier-to-interference ratio (exceeded for 99% of the worst month) used to obtain the overall equivalent protection margin at a test point is the minimum value of the carrier-to-interference ratio obtained assuming:

i) clear-sky conditions (i.e. including atmospheric absorption); *or*

ii) rain-faded conditions corresponding to an attenuation value exceeded for 1% of the worst month.

(MOD)

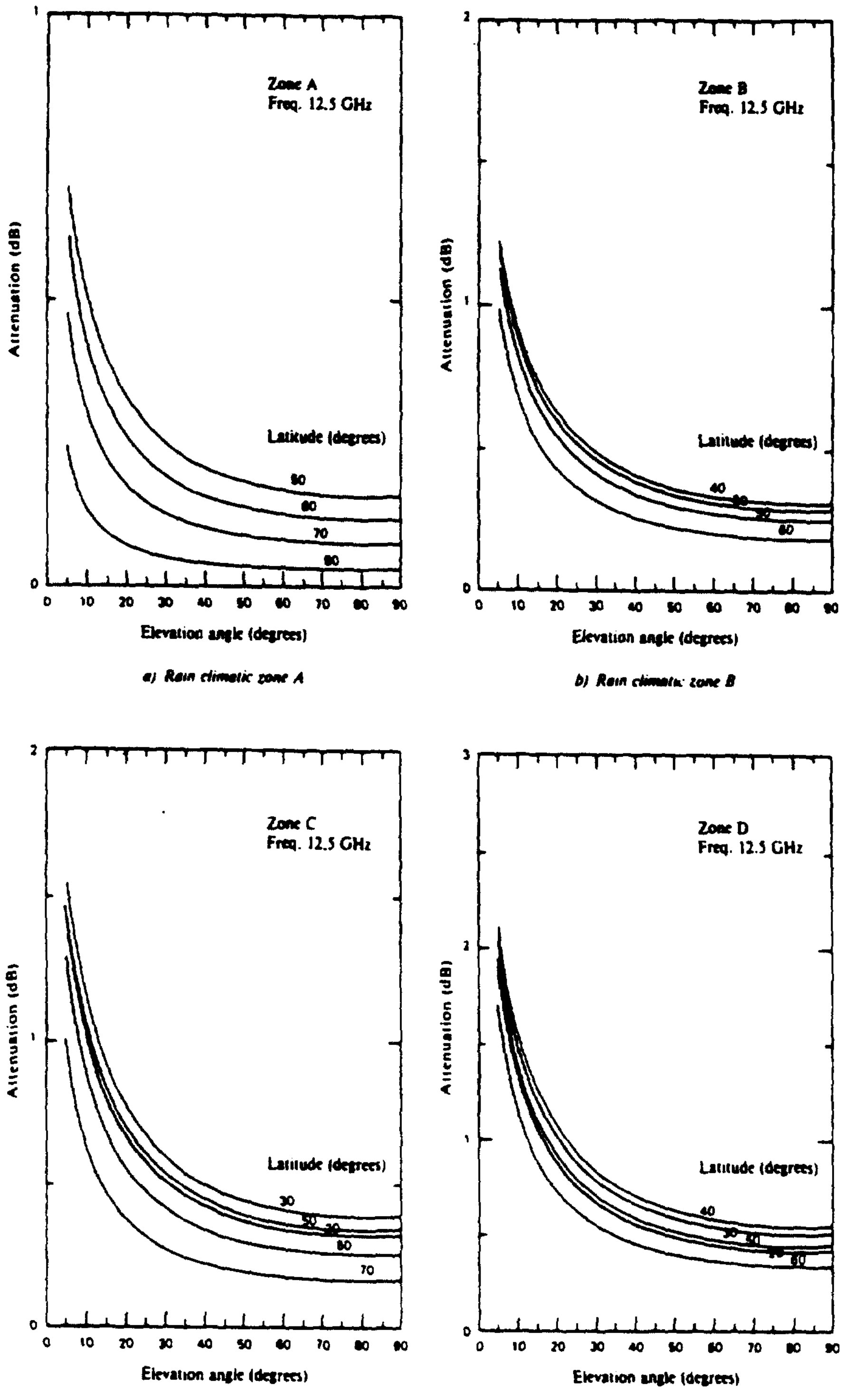
2.3 Depolarization

Rain and ice can cause depolarization of radio frequency signals. The level of the co-polar component relative to the depolarized component is given by the cross-polarization discrimination (XPD) ratio. For circularly polarized emissions, the XPD ratio, in dB, exceeded for 99% of the worst month is obtained from:

$$\mathrm{XPD} = 30 \log f - 40 \log (\cos \theta) - 20 \log A_p \qquad \text{(dB)} \tag{2}$$

$$\text{for } 5° \leq \theta \leq 60°$$

where A_p (dB) is the co-polar rain attenuation exceeded for 1% of the worst month (calculated in Section 2.2), f is the frequency in GHz and θ is the elevation angle. For angles of θ greater than 60°, use $\theta = 60°$ in equation (2).



a) Rain climatic zone A

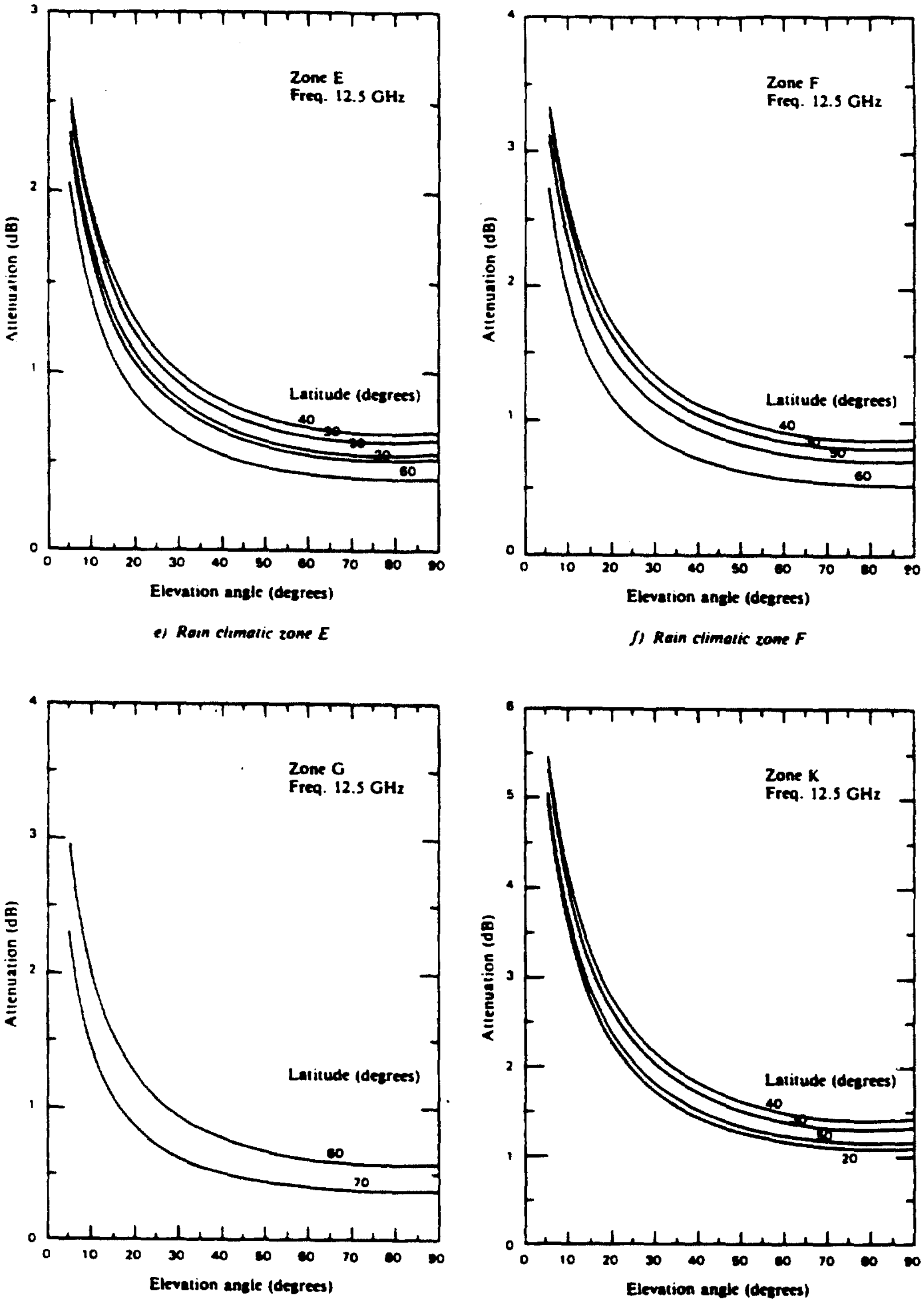
b) Rain climatic zone B

c) Rain climatic zone C

d) Rain climatic zone D

FIGURE 4

Rain attenuation values exceeded for 1% of the worst month (sea level) for Region 2 rain-climatic zones



e) Rain climatic zone E

f) Rain climatic zone F

g) Rain climatic zone G

h) Rain climatic zone K

FIGURE 4 *(cont.)*

Rain attenuation values exceeded for 1% of the worst month (sea level) for Region 2 rain-climatic zones

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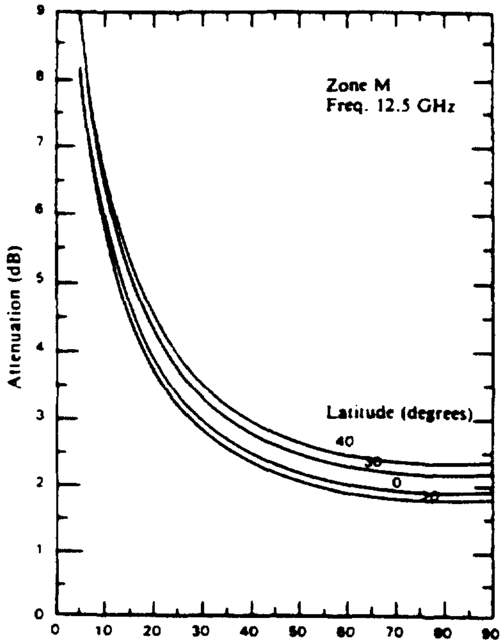
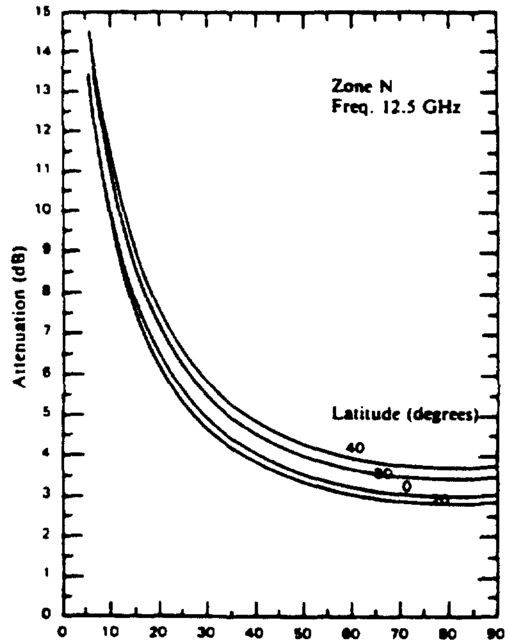
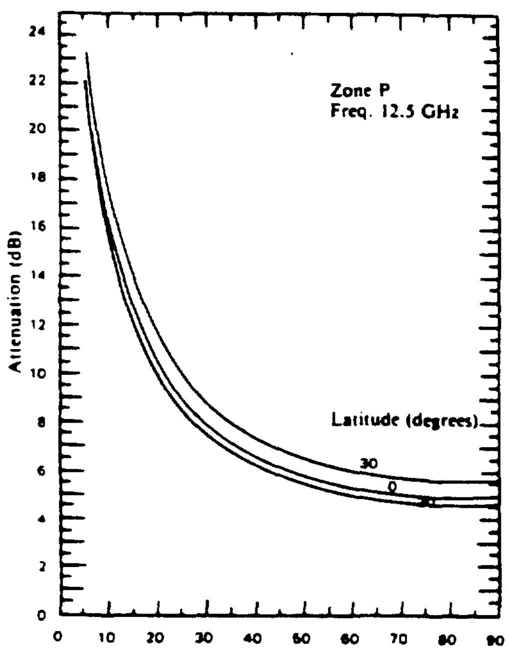


j) Rain climatic zone M



k) Rain climatic zone N



l) Rain climatic zone P

FIGURE 4 *(cont.)*

Rain attenuation values exceeded for 1% of the worst month (sea level) for Region 2 rain-climatic zones

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3. BASIC TECHNICAL CHARACTERISTICS

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3.1 Type of modulation

(MOD)

3.1.1 In Regions 1 and 3, planning of the broadcasting-satellite service is normally based on the use of a signal consisting of a video signal with an associated carrier, frequency-modulated by a sound signal, both frequency-modulating a carrier in the 12 GHz band, with a pre-emphasis characteristic in accordance with Figure 5 (from Recommendation ITU-R F.405-1).

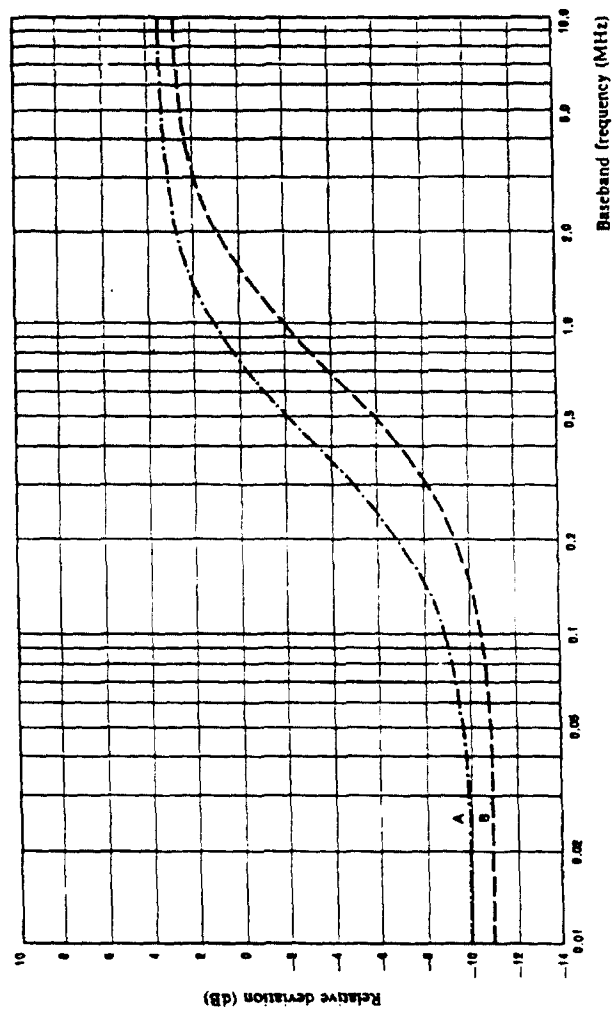

FIGURE 5

Pre-emphasis characteristic for television on 525- and 625-line systems

Curve A: 525-line system

Curve B: 625-line system

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3.1.2 In Region 2, planning is based on the use of a frequency-modulated composite-coded colour television signal with two sound sub-carriers. However, in recognition of the need to provide for the use of new, enhanced television coding and modulation formats (e.g. time-compressed, multiplexed analogue video component signals and digitally-coded sound and data signals), values of the important technical characteristics have been chosen to take into consideration the implementation of these new formats within the provisions of the Plan.

(MOD)

3.1.3 Nevertheless, other modulating signals having different characteristics (e.g. modulation with sound channels frequency-multiplexed within the bandwidth of a television channel, digital modulation of sound and television signals, or other pre-emphasis characteristics) are not precluded, provided that appropriate protection masks and calculation methods[1] are applied or if the use of such characteristics complies with the provisions of paragraph 3.2 of Article 3 of this Appendix.

NOC

3.2 **Polarization**

(MOD)

3.2.1 For the planning of the broadcasting-satellite service, circular polarization is generally used. However, for implementation of assignments in the Plan, linear polarization may also be used, subject to the successful application of the modification procedure of Article 4.

NOC

3.2.2 In Regions 1 and 3, the polarization of different beams intended to serve the same area should, if possible, be the same.

NOC

3.2.3 The terms "direct" and "indirect" used in the Plans to indicate the direction of rotation of circularly-polarized waves correspond to right-hand (clockwise) and left-hand (anti-clockwise) polarization respectively according to the following definitions:

Direct polarization (right-hand or clockwise polarization):

An elliptically or circularly-polarized electromagnetic wave, in which the electric field-intensity vector, observed in any *fixed plane*, normal to the direction of propagation, whilst looking in (i.e. not against) the direction of propagation, rotates *with time* in a *right-hand* or clockwise direction.

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[1] Protection masks for verifying that this provision is met are not yet fully defined in existing ITU-R Recommendations. Recommendations for interference between analogue and digital signals are still under development. In absence of criteria to evaluate interference, the Bureau will use the worst-case approach as adopted by the Radio Regulations Board.

NOTE - For right-hand circularly-polarized plane waves, the ends of the electric vectors drawn from any points along a straight line normal to the plane of the wave front form, *at any instant*, a *left-hand* helix.

Indirect polarization (left-hand or anti-clockwise polarization):

An elliptically or circularly-polarized electromagnetic wave, in which the electric field-intensity vector, observed in any *fixed plane*, normal to the direction of propagation, whilst looking in (i.e. not against) the direction of propagation, rotates *with time* in a *left-hand* or anti-clockwise direction.

NOTE - For left-hand circularly-polarized plane waves, the ends of the electric vectors drawn from any points along a straight line normal to the plane of the wave front form, *at any instant*, a *right-hand* helix.

(ADD)

3.2.4 Linear polarization is defined in Recommendation ITU-R BO.1212. This Recommendation should be used when analysing linearly polarized signals.

NOC

3.3 Carrier-to-noise ratio

For the purpose of planning the broadcasting-satellite service, the carrier-to-noise ratio used is equal to or greater than 14 dB for 99% of the worst month.

In Regions 1 and 3, the reduction in quality in the down-link due to thermal noise in the up-link is taken as equivalent to a degradation in the down-link carrier-to-noise ratio not exceeding 0.5 dB for 99% of the worst month. In Region 2, as a guide for planning, the reduction in quality in the down-link due to thermal noise in the feeder link is taken as equivalent to a degradation in the down-link carrier-to-noise ratio of approximately 0.5 dB not exceeded for 99% of the worst month, but the feeder-link and down-link Plans are evaluated on the basis of the overall carrier-to-noise ratio of 14 dB for the combined down-link and feeder-link contributions.

(MOD)

3.4 Protection ratio between television signals

For developing the original 1977 BSS Plan for Regions 1 and 3, the following protection ratios were used[1]:

- 31 dB for co-channel signals;
- 15 dB for adjacent channel signals.

[1] These protection ratio values may be used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

For revising this Plan at WRC-97, the following aggregate downlink protection ratios were specified in Recommendation ITU-R BO.1297 for the purpose of calculating downlink equivalent protection margins[1]:

- 24 dB for co-channel signals;
- 16 dB for adjacent channel signals;

In revising the Regions 1 and 3 Plan at WRC-97, the following aggregate overall protection ratio values were used (as specified in Recommendation 521 (WRC-95)) for calculating the overall co-channel and adjacent-channel protection margins as defined in Sections 1.8 and 1.9 of this Annex

- 23 dB for co-channel signals;
- 15 dB for adjacent channel signals.

Recommendation 521 also specified that for the revision of the Regions 1 and 3 Plan, no overall co-channel single entry C/I should be lower than 28 dB.

However, for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997 the overall equivalent protection margins were calculated using a co-channel overall protection ratio of 30 dB and lower and upper overall adjacent channel protection ratios of 14 dB[2].

Revision of the Regions 1 and 3 Plan at WRC-97 was generally based on set of reference parameters such as the average e.i.r.p., the reference earth station receiving antenna, all test points placed within -3 dB contour, bandwidth 27 MHz and the predetermined value of C/N.

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[1] The equivalent protection margin M is given in dB by the formula

$$M = -10 \log (10^{-M_1/10} + 10^{-M_2/10} + 10^{-M_3/10})$$

where M_1 is the value in dB of the protection margin for the same channel. This is defined in the following expression where the powers are evaluated at the receiver input:

$$\frac{\text{wanted power}}{\text{sum of the co-channel interfering powers}} \text{(dB)} - \text{co-channel protection ratio (dB)}$$

M_2 and M_3 are the values in dB of the upper and lower adjacent-channel protection margins respectively.

The definition of the adjacent-channel protection margin is similar to that for the co-channel case except that the adjacent-channel protection ratio and the sum of the interfering powers due to emissions in the adjacent channel are considered.

[2] The overall protection margin calculation method used is based on the first formula in 1.12 of Annex 3 to Appendix 30A (S30A).

Protection masks and associated calculation methods for interference into broadcast satellite systems involving digital emissions are given in Recommendation ITU-R BO.1293.

In Region 2, the following protection ratios have been adopted for the purpose of calculating the overall equivalent protection margin[1]:

28 dB for co-channel signals;

13.6 dB for adjacent-channel signals;

-9.9 dB for second adjacent-channel signals.

In Region 2, as a guide for planning, the reduction in the overall carrier-to-interference ratio due to co-channel interference in the feeder link is taken as equivalent to a degradation in the down-link co-channel carrier-to-interference ratio of approximately 0.5 dB not exceeded for 99% of the worst month, but the feeder-link and down-link Plans are evaluated on the basis of the overall equivalent protection margin, which includes the combined down-link and feeder-link contributions.

In Region 2, an overall equivalent protection margin of zero decibels, or greater, indicates that the individual protection ratios have been met for the co-channel, the adjacent channels and the second adjacent channels.

NOC

3.4.1 Adjacent channel protection ratio template for Region 2[2] (FMTV into FMTV)

The protection ratios for adjacent channels are derived from the template given in Figure 6. The template is symmetrical and is given in terms of absolute levels for the carrier-to-interference ratios.

The template is obtained by joining the segment for adjacent channels to the horizontal extension of the co-channel protection ratio value. The adjacent channel protection ratio cannot be adjusted relative to the co-channel value.

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[1] The definitions in Sections 1.7, 1.8, 1.9, 1.10 and 1.11 of this Annex apply to these calculations.

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[2] See Annex 6 for the protection ratio template for interference between TV/FM signals in Regions 1 and 3.

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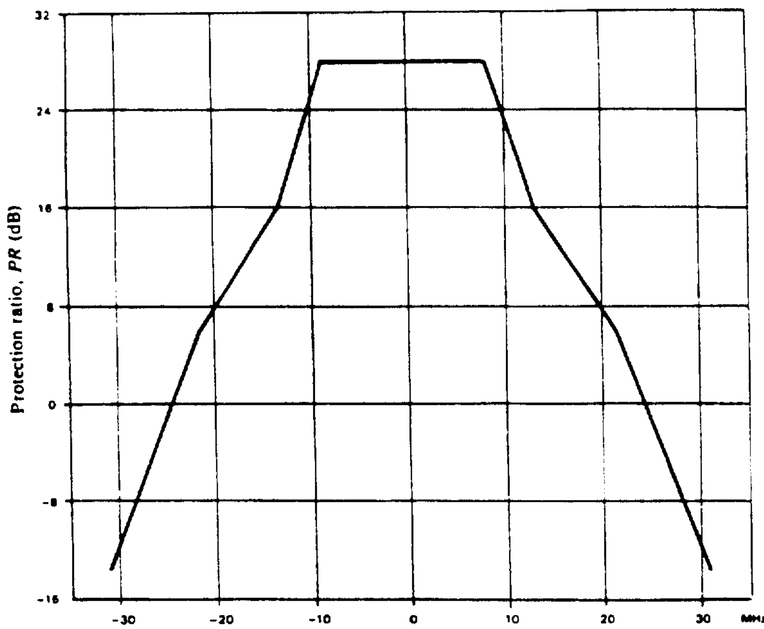

Carrier frequency offset F_0 (MHz)

$F_0 = (f_{int} - f_{wanted})$

FIGURE 6

Protection ratio template (FMTV/FMTV), for planning of broadcasting-satellite systems in Region 2

The template is given by the following expressions:

$$PR = \begin{cases} 28 \text{ dB} & \text{for } |F_0| \leq 8.36 \text{ MHz} \\ -2.762 \; |F_0| + 51.09 \text{ dB} & \text{for } 8.36 < |F_0| \leq 12.87 \text{ MHz} \\ -1.154 \; |F_0| + 30.4 \text{ dB} & \text{for } 12.87 < |F_0| \leq 21.25 \text{ MHz} \\ -2.00 \; |F_0| + 48.38 \text{ dB} & \text{for } |F_0| > 21.25 \text{ MHz} \end{cases}$$

where:

PR is the protection ratio in dB and $|F_0|$ is the carrier spacing between the interfering and wanted signals in MHz.

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3.5 Channel spacing

(MOD)

3.5.1 Channel spacing in the Plans

In Regions 1 and 3, the spacing between the assigned frequencies of two adjacent channels is 19.18 MHz.

In Region 2, the spacing between the assigned frequencies of two adjacent channels is 14.58 MHz, which corresponds to 32 channels in the 500 MHz bandwidth allocated to the broadcasting-satellite service.

The Plans give the assigned frequencies for each channel.

However, in the Regions 1 and 3 Plan, for implementation of assignments different frequency spacing may be used subject to the successful application of the modification procedure of Article 4, ITU-R Recommendations for protection masks should be used if available. In the absence of such Recommendations, BR should apply the worst-case approach as adopted by the Radio Regulations Board.

(MOD)

3.5.2 Arrangement of channels in the same beam

Planning in Region 1 at WARC-77 was carried out by trying to restrict all the channels radiated within a single antenna beam within a frequency range of 400 MHz, in order to simplify receiver construction. Such a restriction was considered unnecessary for the revision of the Regions 1 and 3 Plan at WRC-97.

(MOD)

3.5.3 Spacing between assigned channel frequencies feeding a common antenna

In the 1977 Plan for Regions 1 and 3, owing to technical difficulties in the output circuit of a satellite transmitter, spacing between the assigned frequencies of two channels feeding a common antenna was required to be greater than 40 MHz. This restriction was not imposed in the revision of the Plan.

(MOD)

3.6 Figure of merit (*G/T*) of a receiving station in the broadcasting- satellite service

In planning the broadcasting-satellite service, the value of the figure of merit *G/T* for clear-sky conditions is:

for Regions 1 and 3:

The original 1977 BSS Plan used values[1] of:

6 dB(K^{-1}) for individual reception

14 dB(K^{-1}) for community reception, *and*

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[1] These values are still used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

for Region 2:

10 dB(K^{-1}) for individual reception.

The 1997 revision of the Regions 1 and 3 Plan is based on a uniform value of the figure of merit G/T equal to 11 dB(K^{-1}).

These values were calculated from a formula which allows for pointing error, polarization effects and equipment ageing.

See also Report ITU-R BO.473-3 (Annex 1).

NOC

3.7 Receiving antennas

(MOD)

3.7.1 Half-power beamwidth of receiving antennas

In the development of the original 1977 BSS Plan for Regions 1 and 3, the minimum receiving antenna diameter was such that the half-power beamwidth was 2° for individual reception and 1° for community reception.

In revising this Plan at WRC-97, the minimum receiving antenna diameter was such that the half-power beamwidth was 2.96°.

For planning the broadcasting-satellite service in Region 2, the minimum receiving antenna diameter must be such that the half-power beamwidth φ_0 is 1.7°.

(MOD)

3.7.2 Receiving antenna reference patterns

The co-polar and cross-polar receiving antenna reference patterns are given in Figures 7, 7*bis* and 8.

a) For Regions 1 and 3, the original WARC-77 Plan was based on the antenna pattern[1] shown in Figure 7 where the relative antenna gain (dB) is given by the curves for:

- individual reception, for which use should be made of:
  - Curve A for the co-polar component;
  - Curve B for the cross-polar component;
- community reception, for which use should be made of:
  - Curve A′ up to the intersection with Curve C, then Curve C, for the co-polar component;
  - Curve B for the cross-polar component.

[1] This antenna pattern is used in the BSS Plan for Regions 1 and 3 for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

The WRC-97 revision to the Regions 1 and 3 BSS Plan was based on the absolute gain (dBi) patterns for a 60 cm antenna given in Recommendation ITU-R BO.1213 as shown in Figure 7*bis*.

b) For Region 2, the relative antenna gain (dB) is given by the curves in Figure 8 for individual reception, for which use should be made of:

- Curve A for the co-polar component;
- Curve B for the cross-polar component.

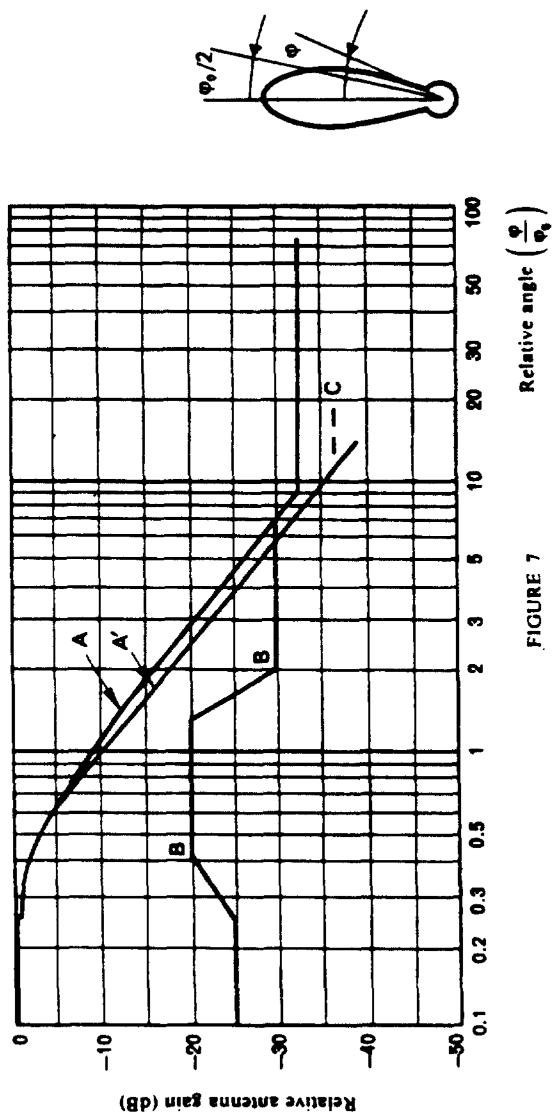

FIGURE 7

Co-polar and cross-polar receiving antenna reference patterns in Regions 1 and 3

(MOD)

Antenna pattern formulae for Figure 7

Curve A: Co-polar component for individual reception without side-lobe suppression (dB relative to main beam gain)

0	for $0 \leq \varphi \leq 0.25\ \varphi_0$
$-12\left(\frac{\varphi}{\varphi_0}\right)^2$	for $0.25\ \varphi_0 < \varphi \leq 0.707\ \varphi_0$
$-\left[9.0 + 20 \log\left(\frac{\varphi}{\varphi_0}\right)\right]$	for $0.707\ \varphi_0 < \varphi \leq 1.26\ \varphi_0$
$-\left[8.5 + 25 \log\left(\frac{\varphi}{\varphi_0}\right)\right]$	for $1.26\ \varphi_0 < \varphi \leq 9.55\ \varphi_0$
-33	for $\varphi > 9.55\ \varphi_0$

Curve A': Co-polar component for community reception without side-lobe suppression (dB relative to main beam gain)

0	for $0 \leq \varphi \leq 0.25\ \varphi_0$
$-12\left(\frac{\varphi}{\varphi_0}\right)^2$	for $0.25\ \varphi_0 < \varphi \leq 0.86\ \varphi_0$
$-\left[10.5 + 25 \log\left(\frac{\varphi}{\varphi_0}\right)\right]$	for $\varphi > 0.86\ \varphi_0$ up to intersection with Curve C (then Curve C)

Curve B: Cross-polar component for both types of reception (dB relative to main beam gain)

-25	for $0 \leq \varphi \leq 0.25\ \varphi_0$
$-\left(30 + 40 \log \left\lvert \frac{\varphi}{\varphi_0} - 1 \right\rvert\right)$	for $0.25\ \varphi_0 < \varphi \leq 0.44\ \varphi_0$
-20	for $0.44\ \varphi_0 < \varphi \leq 1.4\ \varphi_0$
$-\left(30 + 25 \log \left\lvert \frac{\varphi}{\varphi_0} - 1 \right\rvert\right)$	for $1.4\ \varphi_0 < \varphi \leq 2\ \varphi_0$

-30 until intersection with co-polar component curve; then co-polar component curve.

Curve C: Minus the on-axis gain (Curve C in this figure illustrates the particular case of an antenna with an on-axis gain of 37 dBi).

NOTE - for values of φ_0 see Section 3.7.1

(ADD)

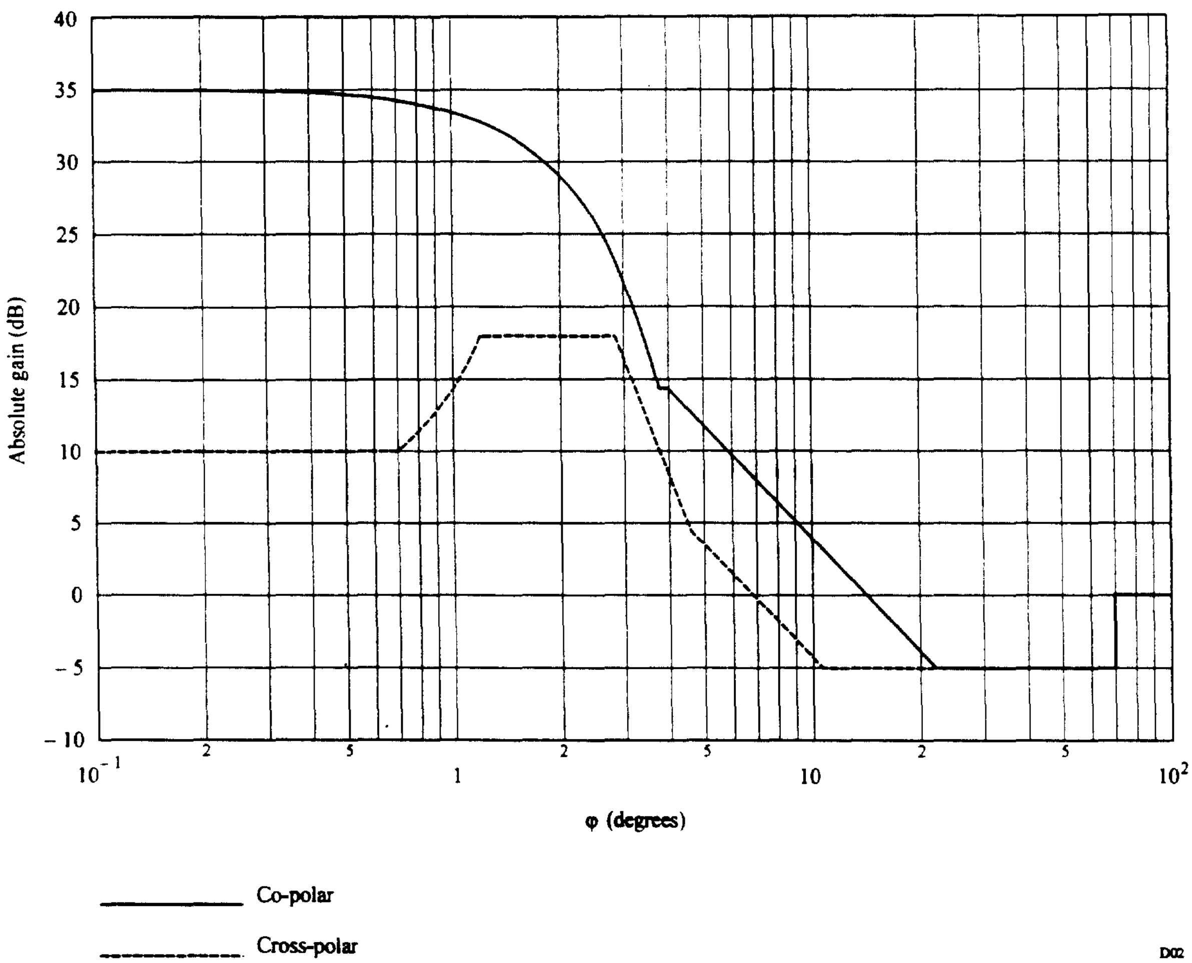

FIGURE 7*bis*

Reference receiving earth station antenna patterns used at WRC-97 for revising the Regions 1 and 3 BSS Plan